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Space Vehicles Directorate: going where no man has gone before

by John Brownlee, Space Vehicles Directorate

KIRTLAND AFB, N.M. – Unless you are the proverbial "rocket scientist," your understanding of the design challenges military spacecraft developers face is probably a little vague.

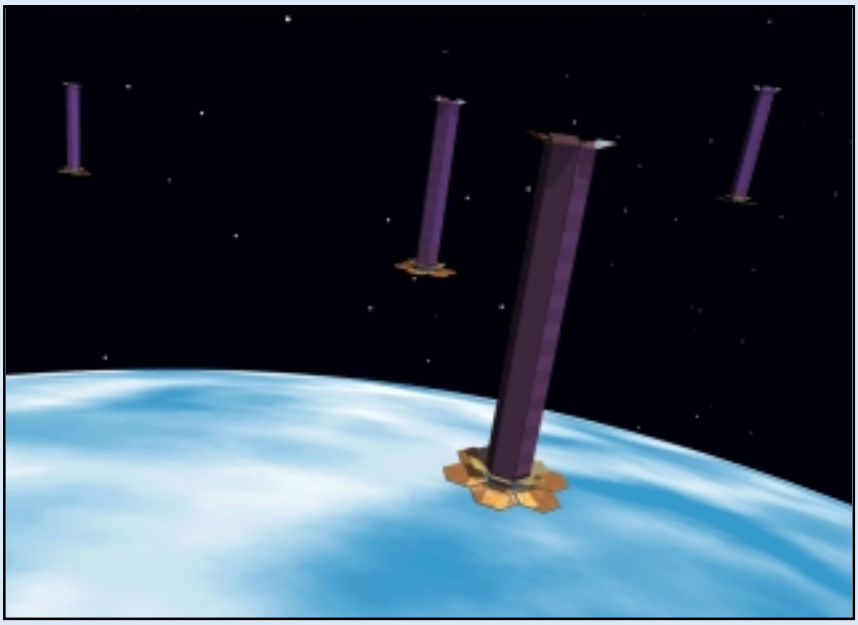
But here at the Air Force Research Laboratory's (AFRL) Space Vehicles Directorate, understanding and overcoming those challenges to create and demonstrate durable, lightweight and affordable space vehicle technologies for the warfighter is anything but vague. It is the primary mission, a mission with highly diverse applications.

Led by Christine Anderson, a talented blend of military and civilian scientists and engineers work daily on the next generation of future space vehicles. Such systems will maximize the Air Force's ability to exploit the tactical and safety advantages space offers — namely, the "high ground" military commanders have historically sought when preparing for war.

Today, however, Directorate men and women must solve problems unimagined in the past. They have to comprehend the aerospace environment—that inhospitable region between the earth and the sun—and how it affects military communication, sensors, and weapon systems and their operations.

Once that area is understood, researchers can then fashion technologies more resistant to natural obstacles — such as cosmic radiation and atomic oxygen — found in space or imposed by physics that menace spacecraft longevity and crucial missions.

Some of AFRL's solutions to those problems include planning more autonomous space systems,"hardening" sensitive electronics against radiation damage; developing more efficient power systems such as new batteries and solar cells; managing unwanted heat inside spacecraft; controlling structural vibrations; studying space debris; designing miniature electronics and mechanical devices; and conducting computer modeling, simulation, and wargames.



FLYING IN FORMATION— TechSat 21 is a planned multi-mission, formation flying cluster of microsatellites. These may some day replace today's single-mission satellites and quickly adapt to rapidly changing warfighter missions.

The resulting new technologies then undergo a series of appropriate ground, airborne, balloon or space validation experiments before they are handed off to the warfighter to become part of the operational Air Force inventory.

And it is here at Kirtland AFB, and at the Directorate's Battlespace Environment Division, located at Hanscom AFB near Boston, Mass., where much of this work is done.

One current Directorate priority in the development of more affordable space systems that are also more responsive to warfighter needs is TechSat 21. TechSat 21 is a planned multi-

mission, formation-flying cluster of microsatellites — each satellite weighing about 100 kilograms (220 pounds)—that may some day replace today's single-mission satellites and quickly adapt to rapidly changing warfighter missions.

Future clusters comprised of three to eight satellites based on TechSat 21 technology will 'talk' to each other and share data processing, payload and mission functions now performed by single conventional satellites. They will also be smaller, lighter, and cost less than current systems because they can be mass produced and placed in orbit using smaller launch vehicles — perhaps even by a military jet such as an F-15.

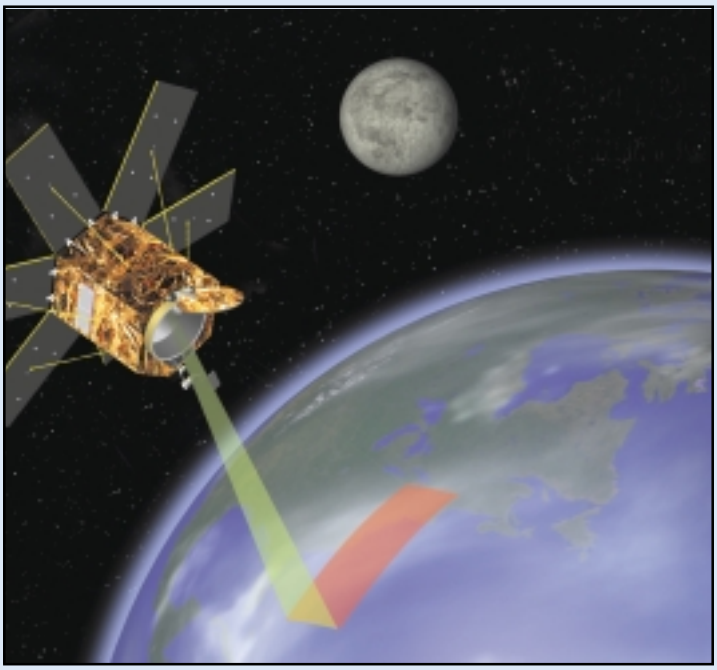
Directorate researchers are also working to ensure that the warfighter of the near future can 'see' more of the battlefield, and see it more clearly than ever before. This will be possible due to the Warfighter-1 program and the advancements now being made in hyperspectral imaging technology.

The Warfighter-1 hyperspectral-imaging instrument is a satellite-based technology that uses different sensors to 'see' energy reflected from objects on the ground. This energy appears in the form of "spectral fingerprints" in the visible, near infrared, and short wave light spectrum.

Once sensors detect these so-called fingerprints, "signature" libraries may be used to identify specific materials — e.g., rooftops, parking lots, grass, mud, different kinds of vehicles — by comparing a library's pre-existing reference catalogs with freshly taken hyperspectral images of a battlefield from space.

This method of remote sensing can also categorize types of terrain and vegetation (useful in counter-narcotics operations), detecting features such as disturbed soil, stressed vegetation, and whether the ground will support the movement of military vehicles.

Reducing the mass of large space structures such as antennas, radar dishes, and optical components by as much as ten times down to a few hundred pounds from many thousands of pounds is also a Directorate specialty. The latest innovation in that effort looks something like an oversized contact lens for a myopic Jolly Green Giant but is actually a potential means to shrink the size and weight of spacecraft and, as a result, lower expensive launch costs.



A VIEW FROM ABOVE— The Warfighter-1 hyperspectral-imaging instrument is satellite-based technology that uses sensors to 'see' energy reflected from objects on the ground.

DID SOMEONE LOSE A CONTACT— Inflatable space structures are a potential means to shrink the size and weight of spacecraft and, as a result, lower expensive launch costs.

Using tightly packed, thin-film plastics such as that depicted in the photograph that inflate and deploy like a life raft from the launch vehicle once it's in orbit may substantially reduce the heavy volume of contemporary stowed metallic or composite payloads. As launch costs today run about $10,000 per pound, lighter and smaller payloads mean the use of cheaper classes of launch vehicles.

Through these examples and many others, AFRL's Space Vehicles Directorate works to advance innovative and affordable space technologies for the warfighter and, ultimately, for the defense of the nation and its allies.

For more information about the Space Vehicles directorate, at http://www.vs.afrl.af.mil/. **@**